PCT/EP2003/010736

Translation

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PC 03 022 H	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP2003/010736	International filing date (*day/month/year*) 26 September 2003 (26.09.2003)	Priority date (*day/month/year*) 27 September 2002 (27.09.2002)
International Patent Classification (IPC) or national classification and IPC G01N 21/77		
Applicant MICRONAS GMBH		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16 March 2004 (16.03.2004)	12 October 2004 (12.10.2004)
Name and mailing address of the IPEA/EP Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/EP2003/010736

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed

☒ the description:

pages 1-13, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☒ the claims:

pages _____, as originally filed
pages _____, as amended (together with any statement under Article 19
pages _____, filed with the demand
pages 1-14, filed with the letter of 13 August 2004 (13.08.2004)

☒ the drawings:

pages 1/6-6/6, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the sequence listing part of the description:

pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-14	YES
	Claims		NO
Inventive step (IS)	Claims	1-14	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-14	YES
	Claims		NO

2. Citations and explanations

1. This report makes reference to the following documents:

D1: WO-A-9706422
D2: WO-A-9533197
D3: WO-A-9533198
D4: DE-A-19947616
D5: US-A-5936730

2. D4, which constitutes the closest prior art, discloses a device as per the preamble of claim 1: that is, a device with a waveguide, on the surface of which a plurality of detection fields are arranged.

3. Problem: To provide a device according to the preamble of claim 1 with a simple and cost-effective design that makes possible a compact structure.

4. Solution: The waveguide is monolithically integrated with the semiconductor substrate or arranged on the semiconductor chip as a waveguide layer, and the radiation receivers of the detection fields are integrated directly on the rear face of the

waveguide facing the detection fields adjacent to each other in the semiconductor substrate.

Thus, an elaborate and expensive imaging lens system between the detection fields and the radiation receivers, as known from D4 (figure 3), is dispensed with.

5. D1 is interesting, since it discloses a device in which the waveguide is monolithically integrated with the semiconductor substrate. Further, an embodiment having a plurality of different detection fields (one detection field per waveguide) is shown (figure 3A). However, a combination of D1 and D4 would not be obvious to a person skilled in the art, since these documents are too dissimilar (in particular, the device described in D1 does not permit locally resolved measurement). Moreover, the feature of claim 1 according to which the radiation receivers are arranged directly on the rear face of the waveguide is absent. D1 (figure 1A) clearly shows that a gap is provided between the waveguide 20 and the radiation receiver 18.

In D2 and D3 the radiation receivers and the waveguides are in a spaced relationship (cf. D4, figure 3).

D5 is not relevant, since the device described therein does not have a waveguide. Total internal reflection is absent in the translucent layer 16, since light from the radiation sources 31 passes through this layer perpendicularly to the interfaces.

6. To summarize, since, for the above-indicated reasons, a person skilled in the art would be required to be inventive in order to arrive at the subject matter of claim 1, said subject matter should be considered to be novel and to involve an inventive step over the available prior art. The same conclusion applies to dependent claims 2-14. The present application therefore meets the requirements of PCT Article 33(2) and (3).

ANNEX TO IPER

Proposal for new claims

[Translator's Note: The major changes are in Claim 1, which has been expanded, and in Claim 2, which is a combination of the previous Claims 2 and 3. The original Claim 12 has been eliminated, and the remaining claim numbers and references have been adjusted accordingly.]

1. Device (1) for the detection of at least one ligand (2) contained in a sample that is to be analyzed, with an optical waveguide (4), on the surface of which at least one receptor (5) is directly or indirectly immobilized which, when it comes into contact with the ligand (2) , forms a specific bond with the ligand (2), with at least one optical source of radiation (8) for injecting excitation radiation (9) into the waveguide (4), the radiation being used for exciting the emission of luminescence radiation (10) as a function of the bonding of the ligand (2) to the receptor (5), and with a semiconductor chip (3) that has at least one radiation receiver (12) on a semiconductor substrate for the individual detection fields to detect the luminescence radiation (10), **characterized by the fact** that the waveguide (4) is monolithically integrated with the semiconductor substrate or is located on the semiconductor (3) or is located in the form of a waveguide layer on the semiconductor chip (3), and that the radiation receivers (12) associated with the detection fields are integrated into the semiconductor substrate facing the detection fields directly on the back side of the waveguide facing away from the detection fields.

2. Device (1) as recited in Claim 1, characterized by the fact that the topography of the semiconductor chip (3), to prevent the undesirable extraction of light from the waveguide (4), is realized so that the boundary surface (14) opposite the at least one receptor (5) between the semiconductor chip (3) and the waveguide (4) runs between two planes (14a, 14b) that are oriented parallel to the plane of extension of the semiconductor chip (3), whereby the distance (x) between said two planes is less than the wavelength of the excitation radiation (9), in particular less than one-half, preferably one-fourth and optionally one-eighth of the wavelength of the excitation radiation (9).

3. Device (1) as recited in one of the Claims 1 or 2, characterized by the fact that the semiconductor chip (3), laterally next to the waveguide (4), has structures (13) for an electronic circuit.

4. Device (1) as recited in one of the Claims 1 to 3, characterized by the fact that between the semiconductor chip (3) and the waveguide (4) there is an intermediate layer (15), the optical index of refraction of which is less than that of the waveguide (4), that the intermediate layer (15) has the negative shape of the semiconductor chip (3), to which it is directly adjacent on the semiconductor chip (3), and that the front side of the intermediate layer (15) that faces away from the semiconductor chip (3) and is directly adjacent to the waveguide (4) is essentially plane.

5 Device (1) as recited in one of the Claims 1 to 4, characterized by the fact that the intermediate layer is realized in the form of an adhesive coating, preferably in the form of a polymer coating.

6. Device (1) as recited in one of the Claims 1 to 7 *[sic - should be 5]*, characterized by the fact that the waveguide (4) is connected with the semiconductor chip (3) by means of at least one bonding point.

7. Device (1) as recited in one of the Claims 1 to 6, characterized by the fact that the waveguide (4) is realized in the form of a thin-film layer that preferably consists of a transparent polymer material, in particular polystyrene.

8. Device (1) as recited in one of the Claims 1 to 7, characterized by the fact that the waveguide (4) is formed by a metal oxide layer, in particular a silicon dioxide layer or a tantalum pentoxide layer.

9. Device (1) as recited in one of the Claims 1 to 8, characterized by the fact that the optical radiation source (8) is realized in the form of a semiconductor radiation source and is integrated into the semiconductor chip (3).

10. Device (1) as recited in one of the Claims 1 to 9, characterized by the fact that for the injection of the excitation radiation (9) into the waveguide (4), an optical injection system

(11) is provided in the emission area of the optical radiation source (8), which system is preferably realized in one piece with the waveguide (4) and in particular has at least one prism, an optical lattice and/or a deflecting mirror.

11. Device (1) as recited in one of the Claims 1 to 10, characterized by the fact that the detection fields are at some distance from one another and are positioned relative to the radiation receivers (12) so that the individual radiation receivers (12) receive essentially no luminescence radiation from a detection field of another radiation receiver (2).

12. Device (1) as recited in one of the Claims 1 to 11, characterized by the fact that the at least one receptor (5) is located in the interior cavity (17) of a flow-through measurement chamber that has at least one inlet opening (19) and one outlet opening (19), and that the semiconductor chip (3) preferably forms a wall area of the flow-through measurement chamber.

13. Device (1) as recited in one of the Claims 1 to 12, characterized by the fact that to control the temperature of the flow-through measurement chamber a heating and/or cooling device is provided, which preferably has a Peltier element.

14. Device (1) as recited in one of the Claims 1 to 13, characterized by the fact that in the flow-through measurement chamber there is at least one reagent and/or reaction partner for the detection of the bonding of the at least one ligand (2) to the at least one receptor (5).

[signature]
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